Measurement of the Normal Spectral Emissivity of Solids at Elevated Temperatures

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As part of its standards development programme, NPL has developed two absolute apparatus for measurement of the normal spectral emissivity of solids at elevated temperatures, one operating from 150°C to 950°C in air, the other from 800°C to 1800°C in vacuum. The apparatus are based on quite different measurement techniques: one transient, the other steady-state. The measurement results and the main sources of uncertainty will be evaluated and discussed.

To further validate the measurement capability of the emissometers, measurements of the emissivity of specimens of Pyroceram 9606, silicon carbide and graphite have been made in vacuum with the high temperature emissometer in the wavelength range $0.65~\mu m - 9.6~\mu 5m$, at temperatures in the range $800^{\circ}C$ - $1600^{\circ}C$ and, where possible, compared with the literature. Measurements were made in air on Pyroceram 9606 and silicon carbide up to $950^{\circ}C$, at wavelengths in the range $2.26~\mu m - 5.06~\mu m$, using the low temperature emissometer, to see how the two apparatus compared.

In the high temperature emissometer a small rotating cylindrical specimen is heated by radiation from a surrounding tantalum tube, and viewed through a 1.5 mm diameter hole in the tube. This radiation is compared with that from a similar-sized blackbody hole in the tube, near to the specimen viewing hole and in the same isothermal region. The emissivity is given by the ratio of the two measured fluxes.

The lower temperature emissometer employs a transient technique in which one plane surface of an isothermal specimen is rapidly exposed and its radiance recorded as a function of time. The data are fitted with a polynomial to determine the initial specimen radiance, which is compared with separate blackbody radiation at the same temperature and wavelength to give the specimen emissivity.